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Three-dimensional Finite Element Modelling Of The Convection Dominated Flow of Non-newtonian Fluid Through a Wire Mesh

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A three-dimensional finite element computer model has been developed to simulate non-Newtonian fluid flow through a wire mesh. The governing equations of continuity and momentum were solved by a mixed finite element method and in conjunction with first order Taylor Galerkin scheme for temporal discretization. A slightly perturbed form of continuity equation is considered in this study in order to satisfy the Ladyzhenskaya-Babuska-Brezzi stability condition. The use of this continuity equation, which corresponds to slightly compressible fluids, allows the utilization of equal order interpolation model for the velocity and pressure. The flow of a highly viscous shear-thickening fluid used in aeronautical filters through a wire mesh has been studied. The influence of weave pattern on downstream flow distribution and pressure drop has been investigated and presented in this paper. A commonly used ratio of wire diameter to aperture was adapted and results have been obtained for shear-thickening fluid with power law index n = 1.3. The simulation results showed the developed model is capable of generating accurate results in solving three-dimensional non-Newtonian flow problems.